CHAPTER 2

PRECOLLEGE EDUCATION

Differences in science and mathematics achievement by sex and by race/ethnicity appear as early as elementary school and widen in secondary school. The lag in achievement by women and minority students may hinder their participation in science and engineering higher education and careers because they have less of a foundation for such pursuits. Many factors contribute to differences in achievement, including course taking, family background, and school characteristics such as tracking, teachers' judgments about ability, number and quality of science and mathematics courses offered, access to qualified teachers, access to resources, and curricula emphases. This chapter examines precollege science and mathematics course taking, achievement, factors influencing achievement, and the transition to higher education.

Mathematics Course Taking

Women

The number of courses taken in mathematics and science is an important indicator of preparation for undergraduate majors in science and engineering as well as of general scientific literacy. Female students are similar to males in mathematics course taking at all levels, according to the 1992 National Education Longitudinal Study Transcripts. More than half of both male and female high school graduates in 1992 had taken algebra I, algebra II, and geometry, but far fewer had taken trigonometry and calculus in high school. Nevertheless, the same percentages of male and female students had taken these advanced courses: 21 percent of both had taken trigonometry and 10 percent of both had taken calculus. Similar percentages of male and female students had taken advanced placement calculus: 6 percent of males and 5 percent of females. (See appendix table 2-1.)

Minorities

Racial/ethnic groups differ greatly in mathematics course taking. Black and Hispanic high school graduates in 1992 were far less likely than white and Asian students to have taken advanced mathematics courses and far more likely to have taken remedial mathematics courses. Thirty-one percent of blacks, 24 percent of Hispanics, and 35 percent of American Indians, compared with about 15 percent of whites and Asians, had taken remedial mathematics in high school. Although about 60 percent of both white and Asian students had taken algebra II, less than half of blacks, Hispanics, and American Indians had taken this course. Asians were most likely of any racial/ethnic group to have taken advanced mathematics courses. Almost one-third of Asians had taken trigonometry, and one-fifth had taken calculus. By contrast, 22 percent of whites, 13 percent of blacks, 15 percent of Hispanics, and 10 percent of American Indians had taken trigonometry, and far smaller percentages took precalculus or calculus. (See appendix table 2-1.)

Although substantial differences in course taking by racial/ethnic groups remain, the percentages of black, Hispanic, and American Indian students taking many basic and advanced mathematics courses doubled between 1982 and 1992. For example, 30 percent of black high school graduates in 1982 had taken geometry, and 1 percent had taken calculus. By 1992, this had increased to 60 percent and 7 percent respectively. (See appendix table 2-1.)

Science Course Taking

Women

Male and female high school students did not differ greatly in science course taking in 1992, except in physics. Similar percentages of both male and female high school graduates had taken biology and chemistry: 92 percent of males and 94 percent of females had taken biology, and 54 percent of males and 57 percent of females had taken chemistry. Male students, however, were more likely than females to have taken physics: 28 percent of males and 21 percent of females had taken physics. Male students were also more likely than females to have taken advanced placement physics. Female students have made gains over the last several years, however: in 1982, only 9 percent of women had taken physics in high school. (See appendix table 2-2.)

A study undertaken by the American Institute of Physics indicates female students are increasing their share of physics enrollment. Women constituted 43 percent of high school physics enrollment in 1993, up from 39 percent in 1987. They were a smaller fraction,

though, of physics students in the more advanced classes. For example, female students were 46 percent of students in the physics for nonscience students classes but only 27 percent of the calculus-based advanced placement course enrollment in physics (Neuschatz and Alpert 1995).

Minorities

Racial/ethnic differences in science course taking are pronounced. Black and Hispanic students are far less likely than white students to have taken advanced science courses. Although black and Hispanic high school graduates are about equally likely as white and Asian students to have taken biology, they are much less likely than whites and Asians to have taken chemistry or physics. Only 46 percent of black, 43 percent of Hispanic, and 33 percent of American Indian high school graduates had taken chemistry compared with 58 percent of white and 67 percent of Asian high school graduates. (See appendix table 2-2.) Although 42 percent of Asian and 26 percent of white students had taken physics, less than 20 percent of black, Hispanic, and American Indian students had taken physics in high school.

Although the gap in science course taking between whites and underrepresented minorities remains, blacks, Hispanics, and American Indians are taking more science classes than they took in the past. The percentage of blacks and Hispanics taking chemistry and physics doubled between 1982 and 1992. In 1982, 23 percent of black and 17 percent of Hispanic high school graduates had taken chemistry. By 1992, this had increased to 46 percent and 43 percent, respectively. In 1982, approximately 7 percent each of blacks and Hispanics had taken physics; by 1992, 18 percent of blacks and 16 percent of Hispanics had taken physics. (See appendix table 2-2.)

Science and Mathematics Achievement

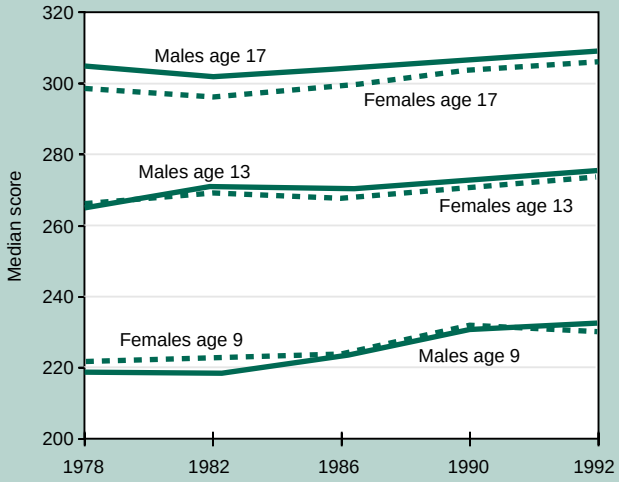
Given the differences in course taking, differences in science and mathematics achievement are not surprising. Trends in science and mathematics achievement since the early 1970s reveal persistent differences by race and sex at ages 9, 13, and 17 despite the narrowing of many gaps.[1]

Women

Male students score slightly higher than female students on the National Assessment of Educational Progress (NAEP) science and mathematics achievement tests at all ages. (See figures 2-1 and 2-2.) At age 17, the gap between males' and females' mathematics and science scores is smaller than in the 1970s, but the narrowing of the gap is not statistically significant.

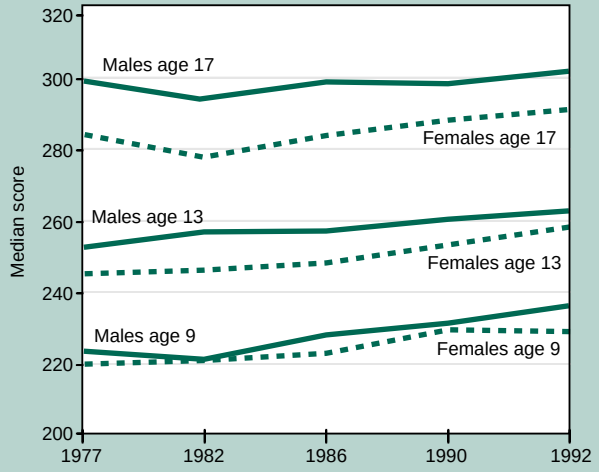
Male and female students have similar mathematics proficiency at ages 9, 13, and 17, although males' average scores are slightly higher. In previous years, female students at age 9 had a slight edge over male students, but in 1992, male scores edged higher than those of females. (See figure 2-1.) Although males showed the most gains at age 9, female students improved most at age 17. The

Figure 2-1.
NAEP mathematics scores at ages 9, 13, and 17, by sex: 1978–1992, selected years



See appendix tables 2-3, 2-4, and 2-5.

Figure 2-2.
NAEP science scores at ages 9, 13, and 17, by sex: 1977–1992, selected years



See appendix tables 2-8, 2-9, and 2-10.

[1] The National Assessment of Educational Progress (NAEP) has been collecting data on student achievement in science and mathematics (and other fields) since 1969. Conducted by the Educational Testing Service under contract with the National Center for Education Statistics, NAEP assesses the academic achievement of a nationwide sample of students at public and private schools to gauge progress in educational attainment.

result of these increases is a similar percentage of males and females scoring at or above selected anchor points. In 1992, 82 percent of males and 81 percent of females scored at or above 200 at age 9, 78 percent of both sexes scored at or above 250 at age 13, and 60 percent of males and 58 percent of females scored at or above 300 at age 17. (See appendix table 2-6.)

Female students also score lower than male students on the NAEP science assessment at ages 9, 13, and 17. (See figure 2-2.) Although the differences are small (from 1 to 3 percent lower), they are statistically significant and have been persistent since 1970 (U.S. Department of Education 1994). The gap between males' and females' science achievement is greatest at age 17, although female students' scores have increased significantly since 1982. In 1982, 45 percent of male and 30 percent of female 17-year-olds scored at or above 300 on the NAEP science assessment. In 1992, 51 percent of males and 42 percent of females in that age group scored at or above 300: a 6-percentage-point increase for males and a 12-percentage-point increase for females. (See appendix table 2-11.)

Minorities

The differences in mathematics and science achievement by race/ethnicity are much more pronounced than differences by sex, although they have narrowed during the past decade. Mathematics scores improved for white, black, and Hispanic students at ages 9, 13, and 17 between 1978 and 1992. (See figure 2-1.) Gains for black and Hispanic students were higher than those for white students. For example, 13 percent more black 17-year-olds and 18 percent more Hispanic 17-year-olds scored at or above 300 compared with 12 percent more white 17-year-olds. (See appendix table 2-6.)

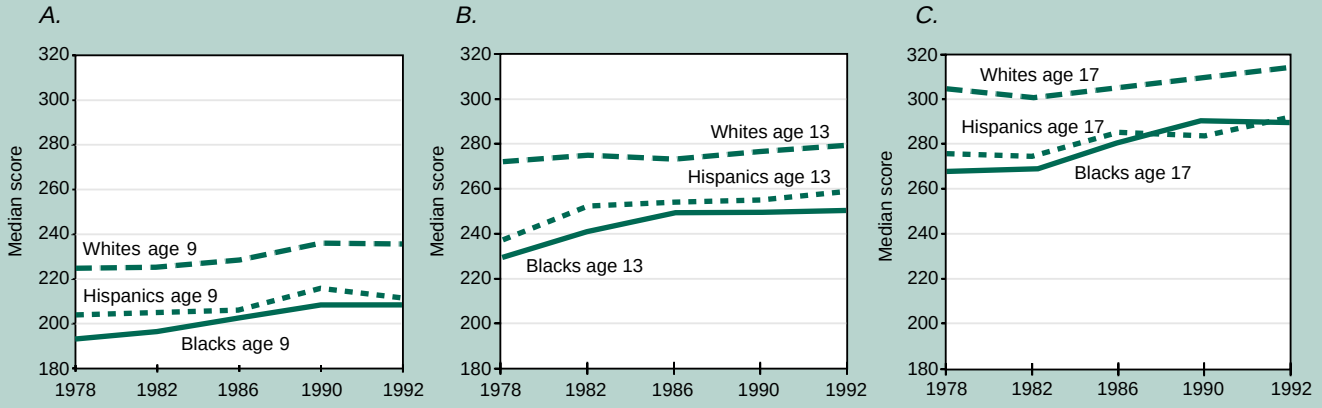
Despite these gains, mathematics scores for black and Hispanic students remain substantially lower than those of white students at all three age levels. (See appendix tables 2-3 to 2-6.) The median scores for black and Hispanic students at all three age levels are lower than the 25th percentile scores for white students. The gap between white and black mathematics scores at ages 9, 13, and 17 narrowed between 1978 and 1992, although it is still substantial. The gap between white and Hispanic mathematics scores narrowed at ages 13 and 17, but has remained constant at age 9. (See figure 2-3.)

As with mathematics scores, differences in science scores persist across racial/ethnic groups. Scores for whites are substantially higher than those for blacks and Hispanics at all age levels, and differences are greatest at age 17. (See figure 2-4.) Science scores increased for students at all three ages between 1982 and 1992, although scores for some groups increased more than others. The gap between black and white and between Hispanic and white science scores narrowed for 9-year-olds between 1982 and 1992. Fifty-one percent of black 9-year-olds scored at or above 200 in 1992, compared with 39 percent in 1982, a 12-percentage-point increase. The percentage of Hispanic 9-year-olds scoring at or above 200 increased from 40 percent in 1982 to 56 percent in 1992, a 15-percentage-point increase. The comparable gain for white 9-year-olds was from 78 percent in 1982 to 86 percent in 1992, a 7-percentage-point increase. (See appendix table 2-11.) No narrowing of the gap was evident for black or Hispanic 13-year-olds or 17-year-olds.

Factors Influencing Achievement

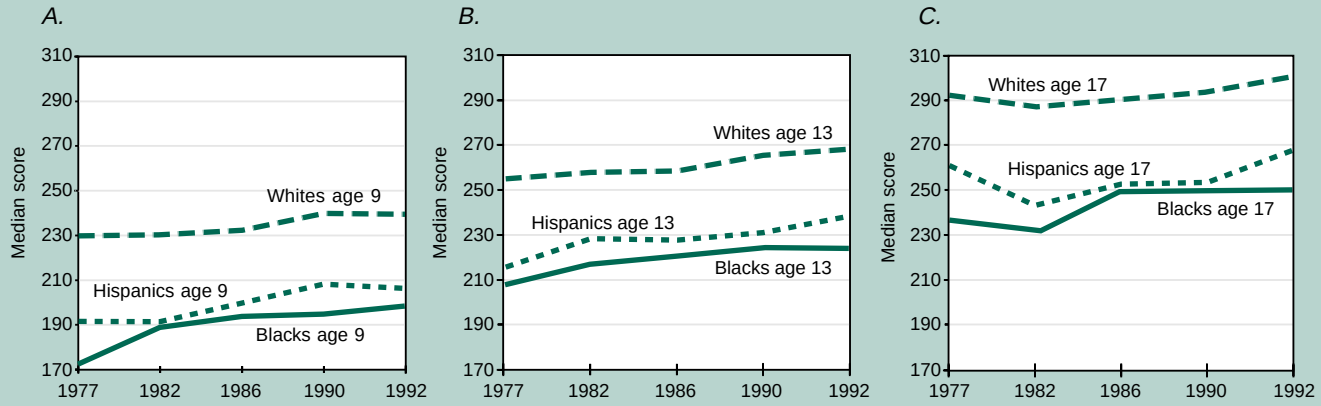
Some of the differences in mathematics and science achievement by race/ethnicity can be explained by family background characteristics and school characteristics

Figure 2-3.
***A.* NAEP mathematics scores at age 9, by race/ethnicity: 1978–1992, selected years. *B.* NAEP mathematics scores at age 13, by race/ethnicity: 1978–1992, selected years. *C.* NAEP mathematics scores at age 17, by race/ethnicity: 1978–1992, selected years.**



See appendix table 2-3. See appendix table 2-4. See appendix table 2-5.

Figure 2-4.
***A.* NAEP science scores at age 9, by race/ethnicity: 1977–1992, selected years. *B.* NAEP science scores at age 13, by race/ethnicity: 1977–1992, selected years. *C.* NAEP science scores by age 17, by race/ethnicity: 1977–1992, selected years**



See appendix table 2-8. See appendix table 2-9. See appendix table 2-10.

other than the role of course taking already cited. Minority students are more likely than white students to come from families in poverty, to have parents with low education levels, and to attend "disadvantaged" schools (Peng et al. 1995).

Family Background

Family background characteristics have a considerable influence on minority participation and achievement in science and mathematics education.

Family Income

Children from poor families have less access to learning materials and educational activities (Oakes 1990a) and are less likely to complete high school. Socioeconomic status (parental occupation, education, and income) accounts for a substantial amount of the differences in mathematics achievement (Ekstrom et al. 1988). Persistence in high school is strongly associated with family income. Students from low-income families are more likely to repeat a grade and to drop out of high school than students from higher income families. One-third of low-income students who repeated a grade were dropouts in 1992. (See appendix table 2-12.)

A larger percentage of minority students than of white students come from families in poverty with less access to learning materials and educational activities (Peng et al. 1995). Black children, in particular, are more likely than other children to live in single-parent families and to live in poverty. Only 34 percent of black children under 18 live with both parents compared with 79 percent of white, non-Hispanic children. (See appendix table 2-13.) Thirty-nine percent of black families with children under 18 are below the poverty level compared with only 12 percent of comparable white, non-Hispanic families.

Parental Education

Parental education is the single most important predictor of participation in mathematics and science (Berryman 1983; Malcom et al. 1985). Those most likely to go to college or to graduate school are those whose parents went to college or to graduate school. The parents serve as role models and mentors in encouraging their children to have high educational aspirations (Oakes 1990a).

Minority students are more likely than white or Asian students to have parents with low educational attainment: 32 percent of Hispanic, 15 percent of black, and 12 percent of American Indian eighth graders, but only 6 percent of white and 8 percent of Asian eighth graders, had parents or guardians who did not finish high school (Pavel et al. 1995, p. 13). Students at all age levels whose parents had less than high school education scored lower in science and mathematics than students whose parents had higher levels of education. Among students ages 9 and 13, however, the science and mathematics scores of students whose parents had less than a high school education improved more since 1978 than those whose parents attended school longer. (See appendix table 2-14.)

Immigrant Status

Mathematics achievement is also related to parental immigrant status. Asian students, regardless of immigrant status, score higher than white students in mathematics at grades 4, 8, and 12. (See appendix table 2-7.) Asian eighth graders whose parents are immigrants (i.e., the children are first- or second-generation immigrants) have higher grades and higher mathematics scores than those whose parents were born in the United States (Kao and Tienda 1995).

Characteristics of Schools

Many factors contribute to unequal participation of minorities in science and mathematics education, including tracking, judgments about ability, number and quality of science and mathematics courses offered, access to qualified teachers, access to resources, and curricula emphases. Schools, particularly secondary schools, in urban areas with a high proportion of economically disadvantaged or minority students offered less access to science and mathematics education (Oakes 1990b).

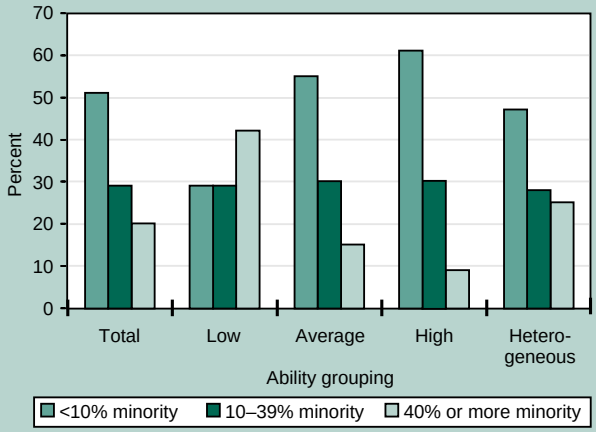
Ability Grouping

Many schools continue to group students according to ability levels. Grouping students by ability level is more prevalent in mathematics than in science and is more prevalent in grades 9–12 than in the lower grades (Weiss 1994). In both science and mathematics, classes with a high proportion of minority students are more likely to be "low-ability" classes than are classes with a low proportion of minority students. For example, in grades 9–12, 29 percent of the classes with a low proportion of minority students are labeled "low-ability" classes, but 42 percent of the classes with at least 40 percent minority students are so labeled. Conversely, 61 percent of the classes with a low proportion of minority students, but only 9 percent of the classes with a high proportion of minority students, are labeled "high-ability" classes. (See figure 2-5.)

Teacher Expectations

Being labeled by ability has a profound impact on student achievement because teachers tend to have different expectations of students in the various groups. Teachers in high-ability classes are more likely to emphasize the development of reasoning and inquiry skills than are those in low-ability classes. Students in low-ability classes are more likely to read from a textbook and less likely to participate in hands-on science

Figure 2-5.
Grades 9–12 mathematics classes by ability grouping and percent minority students: 1993



See appendix table 2-15.

American Indian Schools

Fewer than half of American Indian 12th graders score at or above a basic achievement level in mathematics. (See appendix table 2-7.[2]) American Indians are 1 percent of students attending public schools and Bureau of Indian Affairs (BIA)/tribal schools in the United States. Eight percent of these attend BIA/tribal schools, 36 percent attend public schools with a high (25 percent or more) American Indian enrollment, and 56 percent attend public schools with a low (less than 25 percent) American Indian enrollment (Pavel et al. 1995, p. 10).

Schools with high American Indian enrollment differ from those with low American Indian enrollment in availability of programs and services and in characteristics of teachers. They are more likely to offer compensatory programs and are less likely to offer college preparatory programs. All BIA/tribal schools and 82 percent of public schools with high American Indian enrollment have Chapter 1 programs, which are designed to address the needs of educationally disadvantaged children. (See appendix table 2-19.) By comparison, 66 percent of schools with low American Indian enrollment have Chapter 1 programs. BIA/tribal schools are more likely to offer remedial mathematics (80 percent) than public schools with either high or low American Indian enrollment (61 percent and 60 percent, respectively). College preparatory programs are offered less frequently by BIA/tribal schools (54 percent) and public schools with high American Indian enrollment (55 percent) than by schools with low American Indian enrollment (76 percent). The teachers at BIA/tribal schools and schools with high American Indian enrollment are less likely to be certified, and have fewer years of teaching experience. Both the teachers and the principals in BIA/tribal schools and schools with high American Indian enrollment see poverty, parental alcohol/drug abuse, and lack of parental involvement as serious problems in their schools. (See appendix table 2-20.)

[2] In 1990–1991, the NCES Schools and Staffing Survey conducted an American Indian/Alaskan Native supplement to gather data on the unique characteristics of predominantly American Indian schools.

activities, are more likely to spend time doing worksheet problems, and are less likely to be asked to write reasoning about solving a mathematics problem. (See appendix table 2-16.)

Qualifications of Teachers

Minority students also have less access to qualified teachers. Mathematics classes with a high proportion of minorities are less likely than those with a low proportion of minorities to have mathematics teachers with majors in the field. (See appendix table 2-17.) Schools with a high proportion of minorities, however, do not differ from schools with a lower proportion of minorities in teachers' highest degree earned. (See appendix table 2-18.)

Curriculums Emphases

The instructional emphases in largely minority classes are likely to differ as well. The teachers in science and mathematics classes that have a high percentage of minority students are more likely to emphasize preparing students for standardized tests and are less likely than those having fewer minority students to emphasize preparing students for further study in science or mathematics. (See appendix table 2-17.)

Students With Disabilities

Elementary and secondary students with disabilities have special needs that may hinder their ability to participate fully in science and mathematics instruction. In 1993, approximately 7 percent of students in public elementary and secondary schools received services through programs for students with disabilities. (See appendix table 2-21.)

Special Education Services

The incidence of elementary/secondary students receiving services because of disabilities is increasing. Approximately 6 percent of the population of children in the United States from birth through age 21 were in federally supported special education programs in 1992–1993, compared with 4.5 percent in 1976–1977 (U.S. Department of Education, Office of Special Education and Rehabilitative Services 1994, p. 7). The increase has variously been explained as due to an increased fraction of the Nation's children living in poverty, increased prenatal exposure to alcohol or drugs, or an increase in reporting because of changes in eligibility criteria.

More than half of the children ages 6 through 21 with disabilities had specific learning disabilities, and another one-fifth had speech or language impairments. (See appendix table 2-22.) About 12 percent are mentally retarded, 9 percent have a serious emotional disturbance, and about 1 percent each have orthopedic, hearing, or other health impairments. Less than 1 percent have visual impairments.

Depending on the nature of their disability, students may be served in regular classrooms and be provided with special services via a resource room, or they may receive instruction at a variety of special sites. Special education sites may not offer the same access to science instruction as regular classrooms, because often science instruction needs, especially in the higher grades, are equipment or facility intensive. Students with speech or language impairments were most likely to spend more than half of their class time in regular education academic classes (see appendix table 2-23) and thus have access to science instruction similar to that of students without disabilities. Students with other, less prevalent disabilities, such as hearing or mobility impairments, were more likely to be taught in separate classes.

Science and Mathematics Education

Students with physical disabilities make up 4 to 6 percent of the science students and 2 to 6 percent of the mathematics students in grades 1–12. Students with mental disabilities make up 2 to 9 percent of the science students and 1 to 5 percent of the mathematics students in grades 1–12. Students with mental disabilities are more likely to be included in regular science instruction than in mathematics instruction.

The fraction of students with learning disabilities is much smaller in high school than in the earlier grades. Slightly more than half of the science and mathematics classes in grades 1–4 but only 31 percent of the science classes and 24 percent of the mathematics classes in grades 9–12 have students with learning disabilities. (See figure 2-6.) The fraction of students with physical and mental disabilities is much smaller and varies less by grade. Four percent of science classes and 6 percent of mathematics classes in grades 1–4 have at least one student with a physical disability, compared with 5 percent of science classes and 2 percent of mathematics classes in grades 9–12.

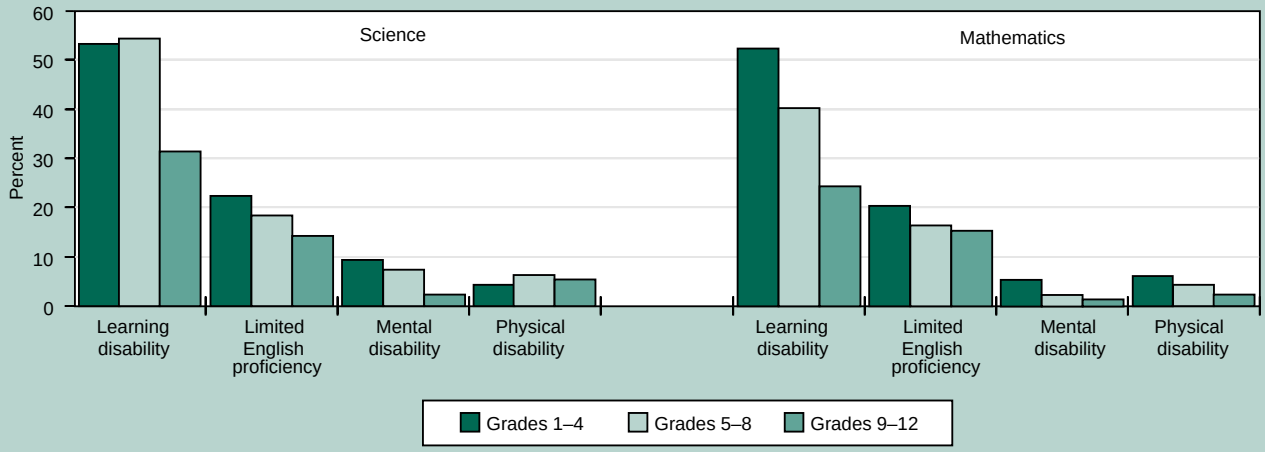
Transition to Higher Education

The transition from elementary/secondary school to higher education is an important step not only to the individuals making it, but also to a nation committed to the well-being of its citizens. Information on persons making this transition provides opportunities for the assessment of their progress through the stages just completed and their readiness for future activities. In this report, the transition points mark an important opportunity for examining the status of underrepresented groups as they progress through the educational system.

College Entrance Examinations

Two organizations administer national college entrance

Figure 2-6.
Percentage of science and mathematics classes with one or more students with disabilities, by grade: 1993



See appendix table 2-24.

examinations—the Admissions Testing Program of the College Entrance Examination Board, which administers the Scholastic Aptitude Test (SAT), and the American College Testing Program, which administers the American College Testing (ACT) Assessment. Results of these examinations are of substantial importance to college admissions decisions and hence to opportunities for college students. A close analysis also offers further insight into the precollege preparation of women and underrepresented minorities. Substantial differences remain in standardized test results among the various groups at the critical transition point from secondary school to higher education.

Women

Scholastic Aptitude Test

The Admissions Testing Program of the College Entrance Examination Board collects and tabulates data on the scores of college-bound seniors who have taken the SAT. The College Board uses the term "college-bound senior" to refer to those students from each high school graduating class who take the SAT Program tests anytime during their high school years.[3] The SAT examination consists of two components: the verbal component, which tests reading comprehension and vocabulary skills, and the mathematics component, which assesses the ability to solve problems by using arithmetic reasoning as well as skills in basic algebra and geometry.[4] The score range for each SAT component is from 200 to 800.

In 1994, almost 1.1 million students took the SAT tests; females constituted 53 percent of the total. (See appendix table 2-25.) Continuing a long-time trend, in 1994 females scored below males in both the mathematics and verbal portions of the SAT. This pattern persists despite the fact that females tend to have higher overall grades in high school than males,[5] and they tend to have better grades in college (see the related discussion on undergraduates in chapter 3). Educators and researchers both in the academic community and within the College Board have been concerned about the underlying causes of this disparity.[6]

[3] Students are counted only once regardless of the number of times they take the same test(s). The College Board reports that these test takers represent approximately 42 percent of all students who enter college each year, and approximately 64 percent of all entering first-year, full-time students. *(College Bound Seniors, 1994 Profile of SAT and Achievement Test Takers.* Princeton, NJ: Educational Testing Service.)

[4] In 1987 the College Board initiated a review of the Admissions Testing Program, and the SAT Program made significant changes in 1993–1994. Through the January 1994 test administration, SAT Program tests included the SAT, the Test of Standard Written English (TSWE), and the Achievement Tests. Beginning in March 1994, the SAT program was revised into two formats: the SAT I: Reasoning Test (the mathematical and verbal sections, with revisions beginning in March 1994) and the SAT II: Subject Tests (formerly known as the Achievement Tests, with the revisions beginning in May 1994).

The College Board reports that the SAT I: Reasoning Test is comparable to the SAT, and therefore scores from this test are included in trend data in this report, and continue to be labeled "SAT." Changes to the Achievement Tests data are noted in the SAT II: Achievement Tests portion of this report. (Data for the TSWE, which is no longer being administered by the College Board, have never been included in the *Women and Minorities* series.)

[5] Based on data reported by the test takers themselves, 21 percent of the females had overall grades of A or A+, whereas 16 percent of the males scored that well. (See appendix table 2-25.)

[6] See, for example, "How Does the SAT Score for Women?" National Coalition for Women and Girls in Education. Washington, DC, July 1990, or "Sex Differences in SAT Predictions of College Grades," Lawrence Stricker, Donald Rock, and Nancy Button. The College Board Report. No. 91-2. New York, NY, 1991.

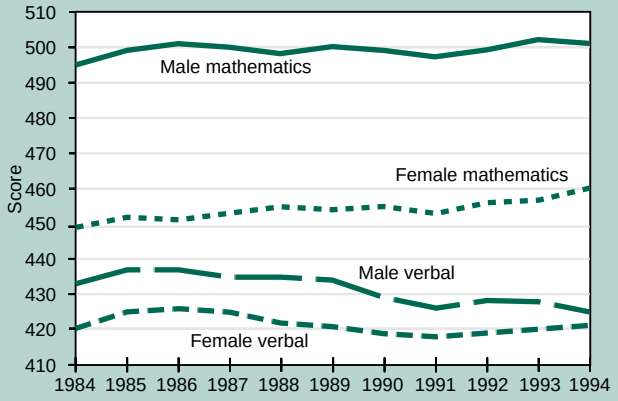
SAT Scores and High School Classes

Mathematics. On the mathematics component of the SAT, scores for both sexes have risen during the decade since 1984, a period of increased emphasis on mathematics and science education at the K–12 level. Nevertheless, females in 1994 continued to score considerably below males in the mathematics component, the gap narrowing only slightly over the decade. (See figure 2-7.) Since 1984, females' scores increased 11 points to 460 in 1994, whereas males' scores increased 6 points to 501. Thus, there was a 41-point difference in scores in 1994, down from a 46-point difference in 1984. (See appendix table 2-26.)

This large difference in mathematics scores between the two sexes occurred despite the similarity in many of their high school characteristics. In 1994, females who took the SAT exam reported completing an average of 3.6 years of mathematics coursework compared with 3.7 years for males. Females received a grade point average of 2.96 in mathematics, compared with a mathematics grade point average of 2.97 for males.[7] (College Entrance Examination Board 1994, p. 10).

Verbal. In 1994, females also continued to score somewhat lower than males on the verbal component of the SAT. (See figure 2-7.) This occurred even though females reported a higher high school grade point average than males in both English and social sciences/history.[8] Females also took a higher average number of years of coursework in English (3.9 years for females versus 3.8 years for males) and social sciences/history (3.4 years for females versus 3.3 years for males) (College Entrance Examination Board 1994, p. 10).

Figure 2-7.
Mean SAT scores, by sex: 1984–1994



NOTE: The score range is 200 to 800.
See appendix table 2-26.

SAT Scores and Level of Difficulty of High School Mathematics and Science Courses

The propensity for taking difficult coursework in high school may account for some of the differences between males and females in mathematics test scores, according to an analysis of the profile data reported by high school seniors who take the SAT. In particular, although males and females had almost the same percentage taking honors courses and had almost identical grade point averages in the mathematics courses they took, a smaller percentage of females took 4 or more years of mathematics,[9] and a much smaller percentage of females took the most advanced coursework.

The discrepancy in course taking between the males and the females taking the SAT occurs in courses that are generally electives, i.e., those following the geometry course. For example, 96 percent of both males and females took algebra, and 93 percent of both genders reported taking a geometry course. There is a gap of 3 percent, however, in male/female participation in both trigonometry (53 percent for females versus 56 percent for males) and precalculus (34 percent for females versus 37 percent for males). The gap widens to a 5 percent difference in the proportion taking calculus (19 percent for females versus 24 percent for males). (See appendix table 2-27.)

This difference in propensity to take the more difficult mathematics courses undoubtedly contributes to the male–female differences in scores. Females were much less likely than males to place in the top range of scores on the mathematics component of the SAT, i.e., in the 600 to 800 range. In 1994, only 14 percent of females scored in this top range versus 24 percent of males. (See appendix table 2-28.)

A similar pattern is evident in enrollment in natural science classes. Females' grade point averages are very similar to males' in the courses they take; both sexes take about the same number of years of coursework; and they participate equally in the percentage taking honors courses.[10]

As is the case with mathematics, however, a smaller percentage of females take the most advanced coursework in the natural science fields. For example, 97 percent of all students who took the SAT, both female and male, had taken biology, and 83 percent of both sexes had taken chemistry. Only 41 percent of females took physics, however, compared with 51 percent of males.

[7] Based on the grading of A = 4 points, B = 3 points, C = 2 points, and D = 1 point.

[8] Females earned a grade point average of 3.26 in English, compared with 3.01 for males; they earned a grade point average of 3.24 in social sciences/history, compared with 3.19 for males.

[9] Seventy-one percent of the males took 4 or more years of mathematics in high school, and 68 percent of the females took that much mathematics. (See appendix table 2-27.)

[10] In 1994, female college-bound seniors reported that they had studied natural science for an average of 3.2 years versus 3.3 years for males. Females earned an average grade point average of 3.09 in the natural science courses they took, versus a slightly lower grade point average of 3.05 for males. The percentage who reported taking an honors course in natural science was identical for both sexes (26 percent).

(See the related discussion above concerning a study by Neuschatz and Alpert, American Institute of Physics.) In coursework intensiveness, 45 percent of females took 4 or more years of natural science, compared with 50 percent of males.

SAT II: Achievement Tests

The differences in coursework taken may also affect the differences between males and females in scores received on the achievement tests offered by the Admissions Testing Program of the College Board.[11] Although females took 50 percent of the achievement tests in science and mathematics in 1994,[12] female participation was concentrated in the less advanced mathematics I exam in which females took 57 percent of the total, and in biology (55 percent of the total). Males took the majority of all the other mathematics and science achievement test exams. Female participation was lowest in physics, in which they took only 26 percent of the exams.

In the mathematics and science achievement tests they did take, females' mean scores were lower than the mean scores for males in 1994. (See appendix table 2-29.) The discrepancy ranged from 31 points on the biology test to 53 points on the physics exam. The spread between scores on the new math level IIC was 45 points (650 for females and 695 for males).

Intended Undergraduate Major

Differences between females and males in their intended preference for degree major are striking for students planning to enter college. Perhaps in keeping with their lower scores on the mathematics SAT, relatively few females about to enter college in 1994 intended to pursue a major in engineering. (See figure 2-8.) Only 3 percent of females intended to major in this subject, whereas 17 percent of males intended to major in engineering, the highest percentage for any individual major for males. (See appendix table 2-30.)

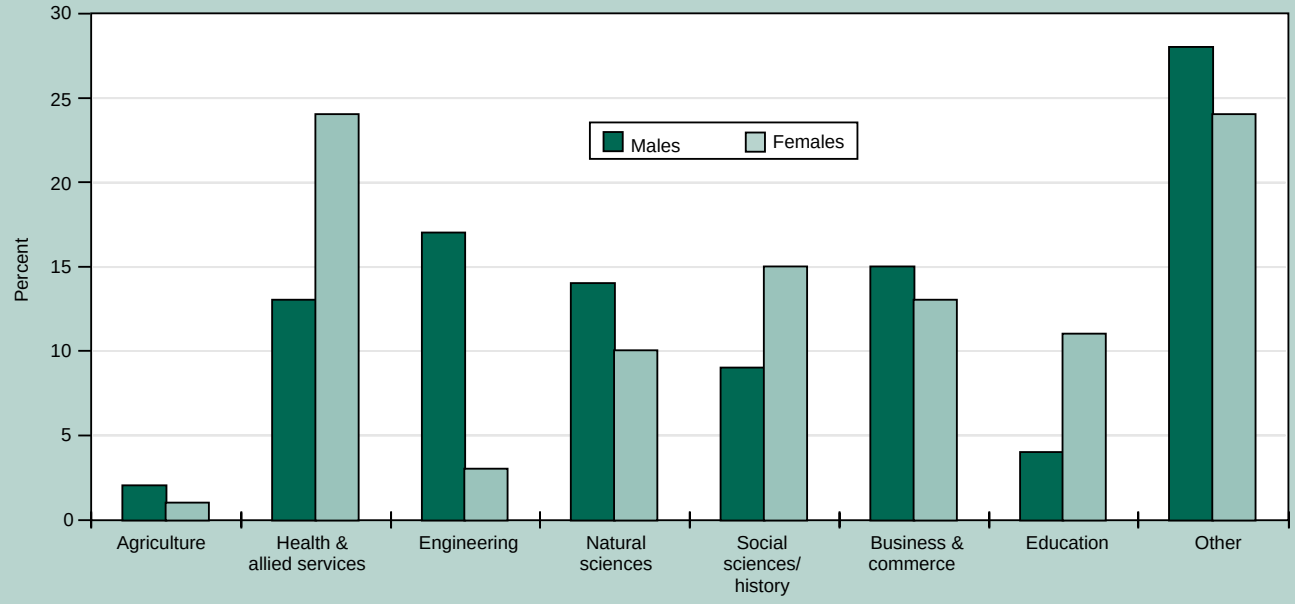
Twenty-four percent of females cited health and allied services as their most probable major. Business and commerce was the next most popular field for women (13 percent), followed by education (11 percent). For males, business and commerce was also the second most popular probable major (15 percent), followed by health and allied services (13 percent). Education was mentioned by just 4 percent of the males.

Combining all natural science fields, 14 percent of the males intended to pursue these majors, and 10 percent of the females chose these fields as probable majors: two percent of males chose agriculture/natural resources as their major, compared with 1 percent of females. One percent of males chose mathematics as a major, and less than 0.05 percent of females did. Double the percentage of males than females also chose the physical sciences (2

[11] Through January 1994, the achievement test series included multiple choice exams in 14 academic areas. Beginning in March 1994, the Achievement Tests were expanded and renamed. They are now called the SAT II: Subject Tests to reflect the addition of new test offerings in various subjects. (Results for the science and mathematics tests, as well as for the new mathematics test, math IIC, are presented in appendix table 2-29.) The College Board reports that students who take achievement tests tend to apply to selective colleges and universities.

[12] Biology, chemistry, physics, math I, math II, and math IIC (first introduced in 1994).

Figure 2-8.
Percentage of college-bound seniors by intended undergraduate major and sex: 1994



See appendix table 2-30.

percent and 1 percent, respectively) and computer sciences (4 percent and 2 percent). Only in the biological sciences did a larger proportion of females choose the discipline—6 percent of females chose biological sciences, compared with 5 percent of males.

Minorities

Scholastic Aptitude Test

Mathematics. An analysis of the descriptive information submitted by students taking the SAT reveals a wide divergence in precollege preparation among the racial/ethnic groups. These differing rates of participation in mathematics and science training in elementary and secondary school are reflected in the scores received on the mathematics portion of the SAT.

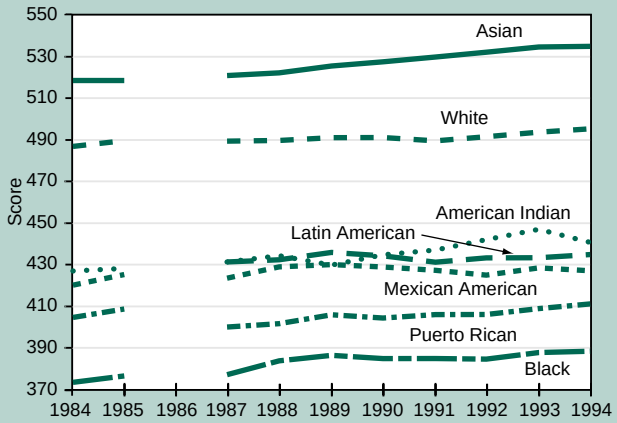
Compared with whites, the three minority groups underrepresented in science and engineering—blacks, Hispanics,[13] and American Indians—tend to take fewer courses in mathematics and science. Asians, who engage in science and engineering in larger proportions than their percentage of the general population, take more science and mathematics high school courses than whites. An analysis of scores reveals that, overall, Asians perform better than all other racial/ethnic groups on the mathematics component of the SAT and on the science and mathematics achievement tests; whites score second highest. Asians also tend to take more of the difficult mathematics and science courses in high school than do students in other groups. (See appendix table 2-27.)

On the mathematics component of the SAT, the scores of every racial/ethnic group improved over the decade, again undoubtedly reflecting increased emphasis on improving mathematics and science education at the K–12 level. (See figure 2-9.) The relative standing of the racial/ethnic groups did not change over the 10-year period, however; the groups scored in the same rank order as in 1984.

In 1994 Asians continued to have the highest average mathematics SAT scores, followed in order by whites and American Indians, Latin Americans, Mexican Americans, Puerto Ricans, and blacks. (See appendix table 2-26.) Asian students also achieved the highest increase in mathematics scores of any racial/ethnic group, with scores rising 16 points over the decade. Black students achieved the second highest increase in scores since 1984 (15 points), and American Indian students achieved a 14-point increase.

[13] Data for Hispanic groups are available separately and are presented in this report at the most detailed level possible. SAT data for Hispanics were subdivided in 1987 from two ethnic groups into three ethnic groups, so that the 10-year trend of specific Hispanic subgroups is not comparable. (The subgroup "Latin American" was available as an option beginning in 1987, in addition to the previously available subgroups "Mexican American" and "Puerto Rican.") Since 1987, scores for those who listed themselves as Latin American tended to be higher than the scores for Mexican Americans or Puerto Ricans.

Figure 2-9.
Mean SAT mathematics scores, by race/ethnicity: 1984–1994



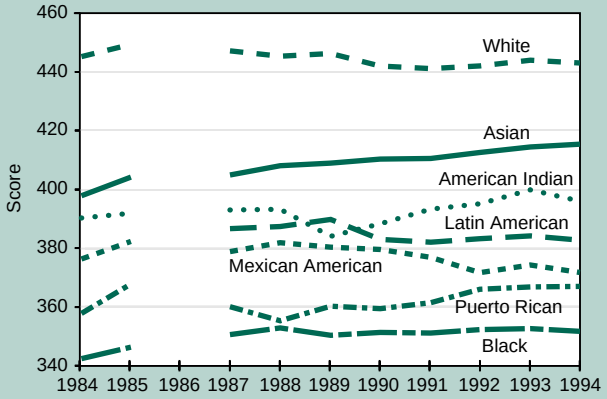
NOTES: The score range is 200 to 800. No data are available for 1986. Data for Latin Americans are not available until 1987.

See appendix table 2-26.

Verbal. On the verbal component of the SAT, whites had the highest mean scores in 1994, followed by Asians and American Indians. (See figure 2-10.) The relative ranking of these groups remained about the same between 1984 and 1994, but several significant changes occurred in the level of the verbal scores. Asians achieved the highest increase in scores of any racial or ethnic group; their verbal scores rose every year for a total increase of 18 points over the decade.

Blacks had the second highest increase in mean verbal scores (10 points), whereas American Indians increased their verbal scores by 6 points. Scores by whites fluctuated slightly over the decade but decreased by 2 points overall between 1984 and 1994. Trend data on Hispanics are more difficult to compare because of

Figure 2-10.
Mean SAT verbal scores, by race/ethnicity: 1984–1994



NOTES: The score range is 200 to 800. No data are available for 1986. Data for Latin Americans are not available until 1987.

See appendix table 2-26.

the data subdivision in 1987. Of the three Hispanic groups, however, only the Puerto Ricans had verbal scores higher in 1994 than in 1987: they rose a total of 7 points by 1994.

SAT Scores and Level of Difficulty of High School Mathematics and Science Courses

The amount and type of coursework taken in high school are related to the scores achieved on the SAT. In particular, Asians and whites, the two groups with the consistently highest mathematics scores on the SAT, were also the two groups who had taken the most courses in mathematics and natural science in high school.

Science. In 1994, 89 percent of college-bound Asians, 85 percent of whites, and 80 percent of Latin Americans took chemistry in high school; roughly three-quarters of each of the other groups took chemistry. The biggest difference in participation rates among racial/ethnic groups in science coursework was in physics. Sixty-five percent of Asians took physics, compared with 47 percent of whites, 44 percent of Latin Americans, and 40 percent of Puerto Ricans. For all the other racial/ethnic groups, less than 35 percent of the college-bound students took physics. (See appendix table 2-27.)

Mathematics. As with females, high percentages of college-bound students from all racial/ethnic groups took algebra and geometry, but the percentage of participation starts to diverge after these two basic high school mathematics courses. Asians were again the most prepared in terms of coursework taken. Sixty-nine percent of Asians took trigonometry, whereas the next highest proportions were 55 percent for whites and 51 percent for Latin Americans. No other racial/ethnic group had a majority of their college-bound seniors taking trigonometry in high school.

The gap widens even further in precalculus: 53 percent of the Asians took that course in high school. The whites' proportion was 17 percentage points behind; 36 percent took precalculus. All other racial/ethnic groups had fewer than one-third of their students taking precalculus in 1994.

Only a minority of all racial/ethnic groups took calculus in high school, yet even here Asians participated at the highest level. Forty percent of Asians took calculus, as did 22 percent of whites. In all other groups, fewer than 20 percent of their student college-bound population took calculus.

Parental Income and SAT Scores

The SAT data show that for every racial/ethnic group, higher reported levels of parental income are generally associated with higher scores on both the verbal and mathematics sections of the SAT. Family income does not uniformly relate to level of achievement, however. The mean SAT mathematics score of 482 for those Asian students at the lowest family income level (under $10,000) exceeded the scores at the highest family levels for several of the underrepresented minorities groups. (See appendix table 2-32.)

Parental Education and SAT Scores

Within every racial/ethnic group, higher levels of parental education were associated with higher students' scores on both the mathematics and verbal portions of the SAT. For example, the difference in mean SAT mathematics scores between the group whose parents did not receive a high school diploma and those whose parents held a graduate degree ranged from 120 points for whites to 85 points for blacks. (See appendix table 2-33.)

A majority of college-bound students in four racial/ethnic groups reported that the highest level of education attained by their parents was a high school diploma or less (Mexican Americans, 70 percent; blacks, 57 percent; Puerto Ricans, 55 percent; and Latin Americans, 54 percent). Although these four groups tended to score lowest on the SAT, within each of these groups the parental education pattern held: average SAT scores increased with the increase in the level of the parents' education.

Citizenship Status and SAT Scores

More than 90 percent of college-bound students taking the SAT in 1994 were U.S. natives or naturalized citizens in all but two of the racial/ethnic groups studied,[14] but only 59 percent of the Asian students taking the SAT and 68 percent of the Latin American students taking the SAT were U.S. natives or naturalized citizens. An additional 27 percent of Asians were permanent residents or refugees, and 15 percent were citizens of another country. For Latin Americans, an additional 23 percent were permanent residents or refugees, and 9 percent were citizens of another country. (See appendix table 2-34.)

Verbal Scores. For all but one racial/ethnic group, verbal SAT scores of U.S. native or naturalized citizens were higher than the verbal scores for either permanent residents/refugees, or for citizens of another country—undoubtedly reflecting the higher proportion of students for whom English is the first language learned. Blacks are the one exception to this pattern of scores. The mean verbal score for black citizens from another country was 29 points above the mean verbal score of black U.S. citizens (381 versus 352). Citizens from another country constituted only 2 percent of blacks taking the SAT, however.

Mathematics Scores. The pattern of higher U.S. citizen scores changes for the mathematics component of the SAT. In all but two racial/ethnic groups—Mexican Americans and Puerto Ricans—the citizens from other

[14] The SAT's descriptive questionnaire also contains a question on citizenship status.

Course Taking and Test Performance

The American College Testing (ACT) Assessment is another national college-entrance examination whose results are used by many college administrators as part of their admissions procedures.[15] Students taking the ACT are asked to self-report details of the high school curriculum that they have taken.

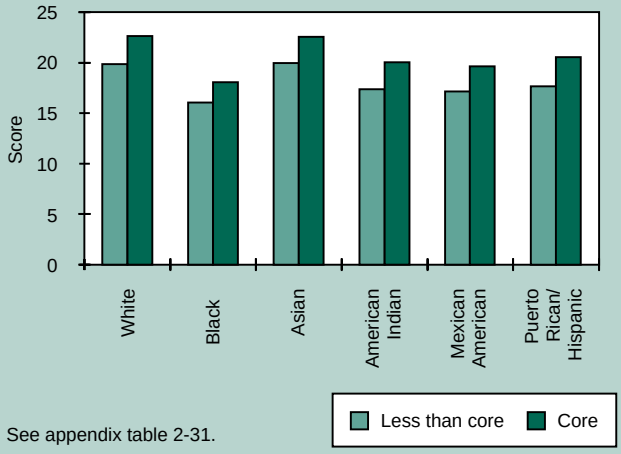
ACT officials have identified a certain series of high school courses as "core" courses, i.e., those that are recommended as college preparatory courses.[16] By correlating the self-reported coursework data with the ACT test scores, ACT officials are able to compare the scores of students who have taken at least the core courses with the scores of students who have taken less than the core curriculum. Students who completed the core subjects scored higher on the ACT tests than those who had not taken all the core courses. An encouraging note is that ACT officials report that over 57 percent of the ACT-tested 1994 high school graduates reported that they had taken the core coursework, a 2.4 percent gain over the 1993 proportion, and an increase of 19 percent since 1987.[17]

In every racial/ethnic group, the composite scores of the students who took the core courses were at least 12 percent above the composite scores of those who had not. An analysis of students taking the core courses reveals a pattern of less participation by the underrepresented minorities. (See figure 2-11.) All ethnic groups, however, are increasing their participation in the core curriculum. In 1993, for example, a majority of white, Asian, and Puerto Rican students took the core courses, but a majority of black and American Indian students did *not* take the core course series in that year, and the number of Mexican American students who took the core courses was virtually even with the number who did not. In 1994, in contrast, a majority of students from all racial/ethnic groups except one took the core courses.

American Indians were the one exception, and those students who took the core course of study scored 17 percent higher on the composite score than the students who did not complete the core coursework, the highest percentage difference in scores of any racial/ethnic group. A majority of both males and females in the American Indian group did not take the core courses (47 percent for both sexes); this ethnic group was the only one in which a majority of the females did not take the core courses. (See appendix table 2-31.) Only a minority of black males took the basic core curriculum (48 percent), whereas a majority of both males and females from all other racial/ethnic groups took at least the core curriculum in 1994.

Analyzed by type of ACT test, females scored higher than their male counterparts in the English and reading tests. Mirroring the results in the SAT mathematics scores, females in each racial/ethnic group scored lower than their male counterparts on the ACT mathematics and science reasoning tests. (See appendix table 2-31.) Across racial/ethnic lines, however, many females scored higher than males in other groups. In fact, female Asians scored higher on the mathematics test than all non-Asian males, for both the core group and those not taking the core curriculum.

Figure 2-11.
Composite ACT scores of students who took core subjects and less than core subjects in high school, by race/ethnicity: 1994



See appendix table 2-31.

[15] ACT officials report that college-bound students who take the ACT Assessment are in some respects not representative of college-bound students nationally. First, students who live in the Midwest, the Rocky Mountains and Plains, and the South are overrepresented among ACT-tested students as compared with college-bound students nationally. In addition, ACT-tested students tend to enroll in public colleges and universities more frequently than do college-bound students nationally (American College Testing Program 1994b).

[16] ACT officials define a "core or more" program as consisting of 4 or more years of English, 3 or more years of mathematics, 3 or more years of social studies, and 3 or more years of natural science. "Less than core" refers to any high school program consisting of fewer courses than those included in core or more.

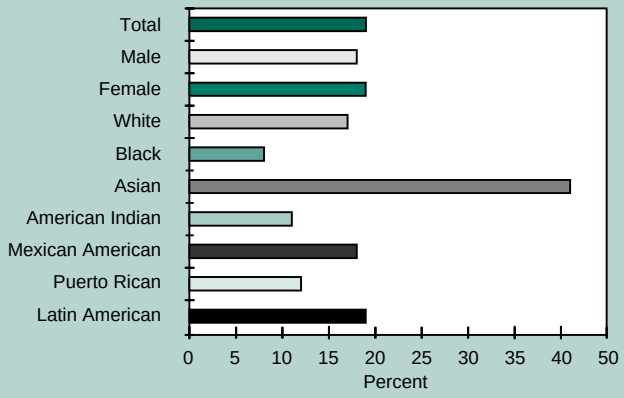
[17] American College Testing Program 1994b, p. 3.

countries achieved higher mathematics SAT scores than did the U.S. citizens. The number of foreign citizens in these two ethnic groups was very small, however, constituting one percent or less of each group.

SAT II: Achievement Tests

Approximately 19 percent of all students who took the SAT in 1994 also took at least one achievement test. The proportion of students taking at least one achievement test varies dramatically by racial/ethnic group. Although whites (17 percent), Mexican Americans (19 percent), and Latin Americans (20 percent) all took achievement tests at a rate similar to the national average of 19 percent, the proportion was lower for Puerto Ricans (12 percent), American Indians (11 percent), and blacks (9 percent). On the other hand, the proportion of Asian SAT takers who also took at least one achievement test (42 percent) was far above the national average. (See figure 2-12.)

Figure 2-12.
Percentage of students taking the SAT who also took at least one achievement test, by sex and race/ethnicity: 1994



SOURCE: College Entrance Examination Board. 1994. *College Bound Seniors, 1994 SAT Profile, Profile of SAT and Achievement Test Takers.* Princeton, NJ: Educational Testing Service.

Intended Undergraduate Major

Racial/ethnic differences in choice of undergraduate major are less dramatic than the differences by sex. Particularly when the social sciences are separated from the natural sciences and engineering, the differences in preference by sex become striking: the proportion of males intending to major in natural sciences and engineering was significantly higher in all racial/ethnic groups than the proportion of females intending to major in these subjects. (See appendix table 2-30.)

For instance, the proportion of males intending to major in natural science/engineering ranged from 28 percent for American Indian and Puerto Rican males to 37 percent for Asian males. For females, however, the proportion intending to study natural science/engineering was much lower, ranging from 12 percent for Mexican Americans to 16 percent for Asians.

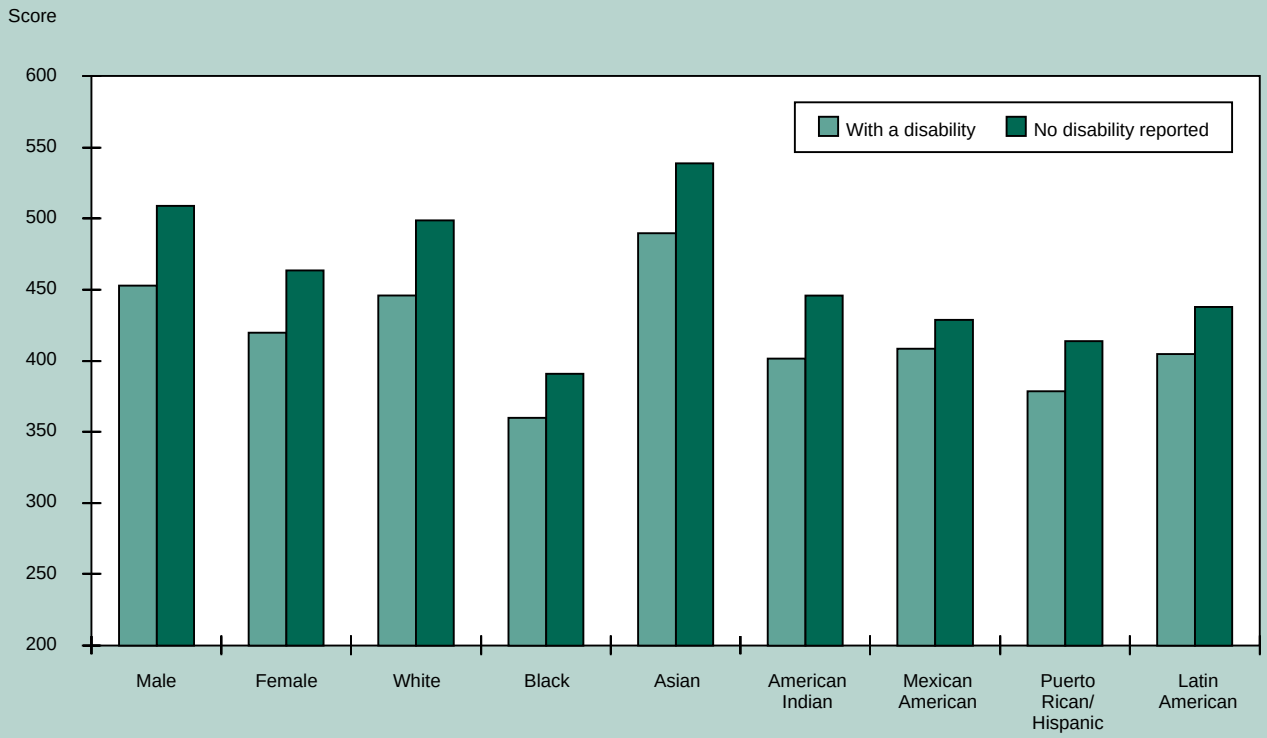
At the time they took the SAT in 1994, only 3 percent of all females intended to study engineering, and females in every racial/ethnic group exhibited the same low priority for engineering study. Black and Asian females intended to major in engineering more often than females of other racial/ethnic groups, but their 5 percent participation was still far below the percentage of males intending to major in engineering (19 percent for blacks and 22 percent for Asians). White and American Indian females were the least likely to choose engineering majors (3 percent each).

Persons With Disabilities

Scholastic Aptitude Test

Four percent of college-bound high school students taking the SAT in 1994 reported a disabling condition; they tended to have lower mean scores on the SAT than did seniors who reported having no disabilities. (See figure 2-13 and appendix table 2-35.) In mathematics, the average score for students with disabilities was 436, compared with 483 for other students. On the verbal exam, the average score for students with disabilities was 391, compared with 427 for students who reported having no disabling condition.

Figure 2-13.
Mean SAT mathematics scores of college-bound seniors, by sex, race/ethnicity, and disability status: 1994



NOTE: Score range is 200 to 800.
See appendix table 2-35.

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